Dkt. 03151

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: Group Art Unit: 3663

MASAKI SANO Examiner: J. Mondt

Serial No.: 10/648,224

Filed: August 27, 2003

For: LIGHT EMITTING DIODE DEVICE

DECLARATION UNDER 37 CFR 1.131

Honorable Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

I, Masaki Sano, do hereby declare as follows:

I am the named inventor of the above-identified patent application.

I am familiar with published US Application 2002/0190262 A1 to Nitta et al cited in the Office Action mailed April 7, 2006 in the above-identified application.

Prior to the filing of the Nitta et al application in the US Patent and Trademark Office on April 8, 2002, I had completed the invention described and claimed in the above-identified patent application.

Attached hereto as Exhibit A is a document in Japanese entitled "SPECIFICATION (DRAFT)" submitted by me to the Development Department which handles intellectual property for Citizen Electronics Co., Ltd, the assignee of the above-identified application. The date on this document has been

removed, but is prior to April 8, 2002. A verified English translation of this document is attached hereto as Exhibit B.

Under the heading "Preferred Embodiment," I have described an example of the invention carried out by me in which a blue light emitting element was mounted and YAG phosphor was mixed in an epoxy resin and molded to form a white LED. Measurements were made of the white light emitted by the molded units prepared.

Three units, representing bluish white, reddish white and greenish white LEDs, respectively, were immersed, respectively, in yellow dye, blue dye and red dye, and the chromaticity of the light emitted by the units was measured after the immersion and drying. The measured chromaticity after the immersion showed correction to white light, and was recognized by me as an invention prior to April 8, 2002.

I further declare that all statements made by me herein are true and all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and may jeopardize the validity of the application or any patent issued thereon.

August 31, 2006
Date

Masaki Sano
Masaki SANO

I, Takeo Okazaki

Residing at 37-15, Shimizu 1-chome,

Suginami-ku, Tokyo,

being competent in Japanese and English languages, certify that to the best of my knowledge and belief the attached English translation is a true and faithful translation made by me of SPECIFICATION (DRAFT) written by Mr. Masaki SANO.

Dated: August 8, 2006

T. Okazaki

(Translation)

SPECIFICATION (DRAFT)

First Electronic Parts
Development Division
Name: Masaki SANO

Title of the invention: Light emitting diode and a method for manufacturing the same

Field of industrial exploitation: Method for manufacturing a white LED and others

Examples of prior art

Prior art:

In order to realize an LED for emitting white light, there is a method where blue or ultraviolet light emitting element is mounted, and molded into a molding resin of such material as epoxy wherein phosphors of yellow, or the three primary colors, R, G, B are mixed. By further mixing a colorant as a color filter in the white LED, LEDs of various hues and color purities can be obtained.

Problems to be solved in the invention:

When the LEDs for emitting white and other colors of light are manufactured by the above method, the color of light is likely to vary so that the color dispersion within a single lot is increased. Therefore there are problems such as low yield, requiring a large effort for classifying chromaticity and maintaining the yield, and color variances within a set where a plurality of LEDs are used.

The color distribution can be attributed to the fact that the composition ratio among the molding resin, phosphors and pigments cannot be kept constant due to the differences in specific gravities thereof, and to distribution of wavelength of light from the light emitting element.

It is difficult to improve the color dispersion in the conventional method.

Preferred embodiment

A blue light emitting element is mounted and YAG phosphor is mixed in epoxy resin and molded, thereby forming a white LED. The average values of coordinates of the white LEDs are $x = 0.295$ and $y = 0.290$, and the dispersion is $\sigma x = 0.015$ and $\sigma y = 0.01$ (N = 10K). The LEDs are classified and corrected as follows.

Bluish white LED: Immersed in a dye liquid comprising alcohol including dye of naphthoquinone group (yellow dye) of 100 ppm for fifteen minutes while stirring, so as to be dyed, and then dried. Yellowish white LED: Immersed in a dye liquid comprising alcohol including dye of anthraquinone group (blue dye) of 100 ppm for ten minutes while stirring, so as to be dyed, and then dried. Reddish white LED: Immersed in a dye liquid comprising alcohol including dye of naphthoquinone group (yellow dye) of 50 ppm and dye of anthraquinone group (blue dye) of 30 ppm for five minutes while stirring, so as to be dyed, and then dried. Greenish white LED: Immersed in a dye liquid comprising alcohol including dye of monoazo group (red dye) of 70 ppm for ten minutes while stirring, so as to be dyed, and then dried. Average coordinates of chromaticity after these corrections were x = 0.313, y = 0.308, σ x = 0.005, σ y = 0.003, and the desired chromaticity was converged without dispersing.
Steps to solve the problems
1-1. Produce white LEDs in accordance with the conventional method.
1-2. Classify the LEDs depending on the chromaticity and pick up LEDs, the chromaticity of which is deviated.
1-3. Immerse the LEDs in a dye liquid comprising permeable organic solvent or warm water in which dye is dissolved or dispersed at an appropriate concentration, stirred and dried so as to be dyed, thereby correcting the chromaticity of emitted light by reducing the unnecessary color components.
2. LEDs of various hues and color purities can be manufactured without causing dispersion using only white LED and dye and without mixing colorant in the molding resin.
*The advantage of correcting the chromaticity by dying or coloring is that the fine adjustment of chromaticity is possible by selecting the solvent, dye concentration, immersion time, and others.
Operation
Effect of the invention:
White LEDs and LEDs of various colors can be manufactured without dispersion so that yield is increased, effort needed for classifying

chromaticity and maintaining yield is reduced, and color variances within a set where a plurality of LEDs are used is reduced.

CITIZEN ELECTRONICS CO., LTD.

(CE Form 19 H8. 3. 4)

明　細　書　（案）

No.732

所属：第一電子部品開発課　氏名：佐野 正樹

発明（考案）の名称：発光ダイオードおよびその製造方法

産業上の利用分野：白色LED等の製造方法

従来例

従来の技術：

白色LEDの実現方式として、青あるいは紫外発光素子を実装し、黄色あるいはR、G，Bの３原色蛍光体をエポキシ等のモールド樹脂に混練して成型する方法がある。また、この白色LEDに色フィルターとして着色剤を一緒に混練することにより、あらゆる色相、色純度のLEDを実現することもできる。

発明（考案）が解決しようとする問題点：

上記の方法で白色等のLEDを製造した場合、発光色のばらつきが起き易くロット内で大きな色度分布をとる。よって歩留まりが低い、色度分類・収率確保に多大な労力を要する、複数使いするセット内では色ムラとなるなどの問題がある。

色ばらつきの原因として、モールド樹脂・蛍光体・着色剤の比重差により組成比が一定に保てないことや素子の発光波長のばらつきなどが挙げられる。

このような色ばらつきを従来工程内で改善することは困難である。

実施例　青色発光素子を実装し、エポキシ樹脂にYAG蛍光体を混練して成型して白色LEDとする。このとき色度座標は平均値x=0.295、y=0.290で、σx=0.015、σy=0.01（N=10K）の分布となった。これを分類して以下の補正を行った。

青色寄りのもの：ﾅﾌﾄｷﾉﾝ系染料（黄系）100ppmをｱﾙｺｰﾙ中に分散させた染色液体に15分浸漬･攪拌して染色し乾燥した

黄色寄りのもの：ｱﾝﾄﾗｷﾉﾝ系染料（青系）100ppmをｱﾙｺｰﾙ中に分散させた染料液体に10分浸漬･攪拌して染色し乾燥した。

赤色寄りのもの：ﾅﾌﾄｷﾉﾝ系染料（黄系）50ppm、ｱﾝﾄﾗｷﾉﾝ系染料（青系）30ppmをｱﾙｺｰﾙ中に分散させた染料液体に5分浸漬･攪拌して染色し乾燥した。

緑色寄りのもの：ﾓﾉｱｿﾞ系染料（赤系）70ppmをｱﾙｺｰﾙ中に分散させた染料液体に10分浸漬･攪拌して染色し乾燥した。

このような補正後の色度座標は平均値x=0.313、y=0.308で、σx=0.005、σy=0.003となり、目標の色度にばらつきなく集約できた。

問題点を解決するための手段：

1-1.従来の方法にて白色LED等を製造する。

1-2.色度分類し、色度ズレのものをピックアップする。

1-3.浸透性のある有機溶剤または温水中に染料を適当な濃度で溶解または分散させてなる染料液に、該LEDを浸漬・攪拌、乾燥して染色し、不用な発光色成分を弱めることで発光色度の補正を行う。

2.着色剤をモールド樹脂に全く混練せずに、白色LED＋染色のみであらゆる色相、色純度のLEDをばらつきなく製造することもできる。

＊ 染色による色度補正または着色の利点として、選択溶媒・染料濃度・浸漬時間等で微妙な色度調整が可能なことである。

作用：

発明（考案）の効果：

白色LEDやあらゆる発光色のLEDをばらつきなく製造でき、歩留まり向上、色度分類・収率確保の労力削減が可能となる。LEDを複数使いするセット内での色ムラ低減ができる。